



## NEP TECHNOLOGY - FY 92 MILESTONES (NASA LERC)

### THRUSTERS

- o ESTABLISH 100 H TEST CAPABILITY FOR 100 KW MPD THRUSTERS
- o DEMO LIGHTWEIGHT 20-KW KRYPTON ION THRUSTER
- o OPTIMIZE THE DESIGN OF LOW MASS POWER PROCESSOR TRANSFORMERS

### NEP FACILITIES

- o COMPLETE EPL'S TANK 5 CRYOPUMP UPGRADE

Presented by: Jim Sovay  
NASA Lewis Research Center



## NEP TECHNOLOGY - FY92 RESOURCES (NASA LERC)

### THRUSTERS

- o \$129K, MPD THRUSTER TECHNOLOGY
- o \$18K, TANK 5 CONSUMABLES
- o \$23K, ION OPTICS
- o \$30K, WITH \$35K (BASE R&T) FOR PPU MAGNETICS, UNIVERSITY OF WISCONSIN

### NEP FACILITIES

- o \$40K, TANK 5 CRYOPUMP UPGRADE

## NEP - ION THRUSTER TECHNOLOGY (NASA LERC)

### ACCOMPLISHMENTS.....THRUSTER

- o PERFORMANCE OF VIBRATION WORTHY 50-CM DIAMETER THRUSTER DESIGN COMPARABLE TO SOA DESIGNS
- o LIGHTWEIGHT 30-CM THRUSTER ASSEMBLED UNDER BASE R&T PROGRAM
- o 16 PAIRS OF DISHED ACCELERATOR GRIDS ARE NOW BEING FABRICATED..... TESTING SCHEDULED FOR FEBRUARY 1993.

### POWER PROCESSOR

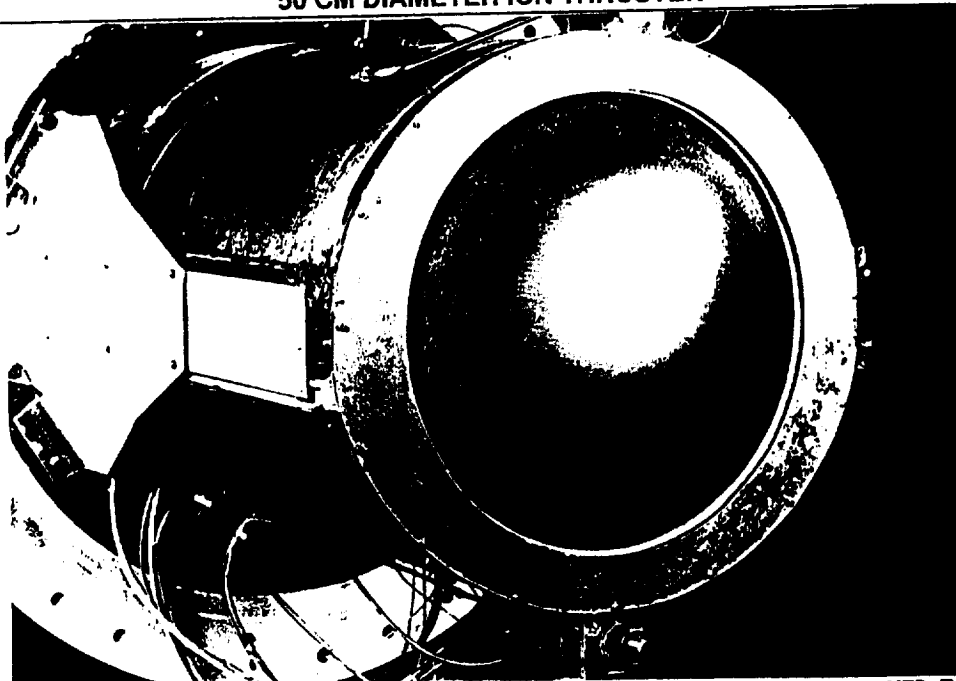
- o ANALYSIS OF FULL-BRIDGE, LOW VOLTAGE DC/DC CONVERTER COMPLETE
- o DETAILED ANALYSIS, TRADE-OFFS, AND DESIGN OF TRANSFORMERS COMPLETE
- o FOLLOW-ON WILL PROVIDE CONVERTER HARDWARE



SPACE PROPULSION TECHNOLOGY DIVISION

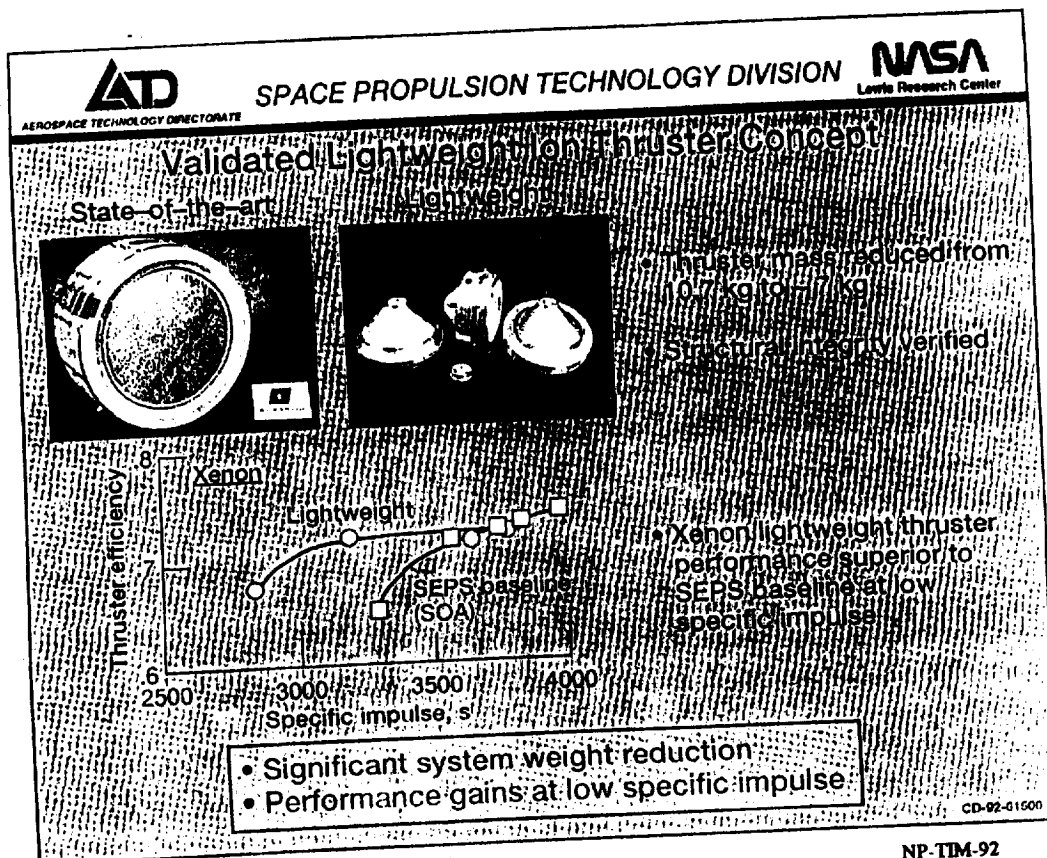
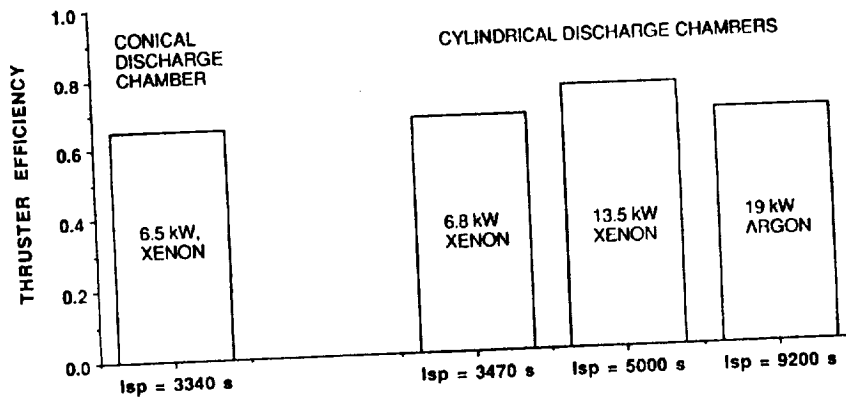


### 50 CM DIAMETER ION THRUSTER



## 50 CM DIAMETER ION THRUSTER PERFORMANCE

VIBRATION WORTHY CONICAL DISCHARGE CHAMBER DESIGN HAS PERFORMANCE COMPARABLE TO SOA CYLINDRICAL DESIGN



LERC/JPL COORDINATED ION PROPULSION PROGRAM  
SUPPORTED UNDER BASE R&T STARTING FY93

LERC/JPL COORDINATED ION PROPULSION TECHNOLOGY PROGRAM

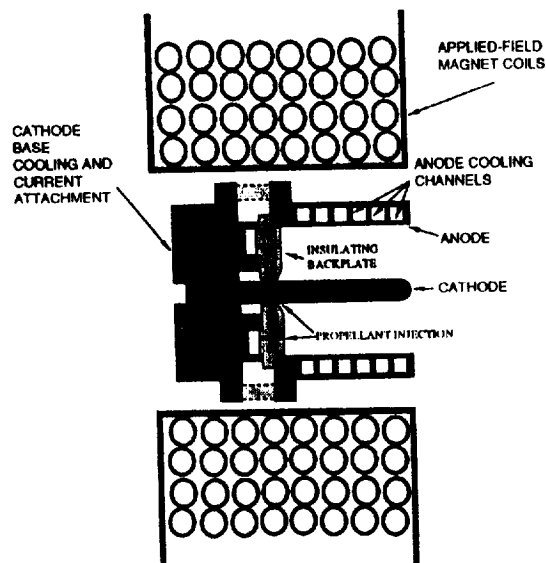
	FY93	FY94	FY95	AGENT (L: LERC, J: JPL)
1. THRUSTER DEVELOPMENT	DOEING * AEROSP. * VID. WFAII			L
o LIGHTWEIGHT 30 CM	BOEING * AEROSP. * CSTAP			L
o POWER CONSOLE DEL.	COMPLETE			J
o SEG. THR. SYS. EVAL.	EXP EVAL * 1-SEG WEAIR * 5-KW WEAIR			J
o 5 KW SEG. THRUSTER	11-12, 25 kW			L
o LIGHTWEIGHT 50 CM				
o DOWNSELECT THR. FOR SEP OR NEP				L, J
2. CATHODE DEVELOPMENT		DEFINE		L (SSF)
o PROTOCOLS				L (W. MPD)
o DIAGNOSTICS/MODELS	THERMAL	PLASMA		
3. GRID DEVELOPMENT				J
o CARBON-CARBON		15 CM	30 CM EVAL	L
o 30 & 50 CM MOLY		PERV.	LOW WEAR	L, J
o DOWNSELECT				L
o LASER DIAGNOSTICS	CONTOURS		EVAL. HOLOGR.	L, J
o CHANGE EXCH. STUDY	PRELIM MODEL		IMPROVED MODEL LIFE PHED	
4. POWER PROCESSOR				L
o COMPONENT TECH.	LITE MAG.		HV INVERTER	L
o SIMPLIFIED PPU	LAD DEMO	LV BBS	DO DEMO	L
o PACKAGED PPU		SOW	ATP	J
5. DD FEED SYSTEM LIFE				
6. DIAGNOSTICS				L, J
o THRUST STAND	COMPLETE			L, J
o BEAM DIAGNOSTICS	CHG. STATE		T-VICION	

## NEP - MPD THRUSTER TECHNOLOGY

FY 92 Milestone: Establish 100 hr test capability at 100 kW

### Background:

- Base Technology Program supported extensive testing of
  - argon MPD thrusters to 240 kW
  - hydrogen thrusters to 100 kW
- Extensive performance data base established



### Applied-Field MPD thruster schematic

Anode and cathode lengths of 7.6 cm. Cathode radius = 0.64 cm, anode radii of 2.54, 3.81, and 5.1 cm. Thrust exit plane was even with solenoid exit plane.



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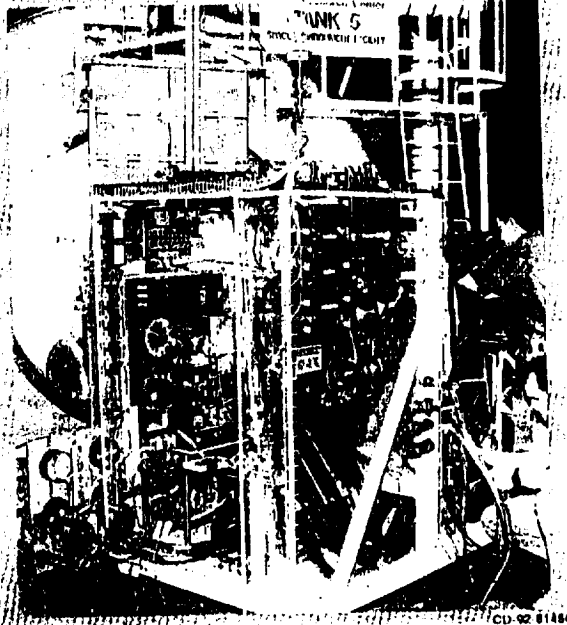
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## High Power Electric Propulsion MPD Thruster Technology

- New facility established
  - Helium cryopumping
  - 350 kW power
  - Plume diagnostics
  - Electrode power diagnostics
- MPD thruster tested to 240 kW



CD-92-01486



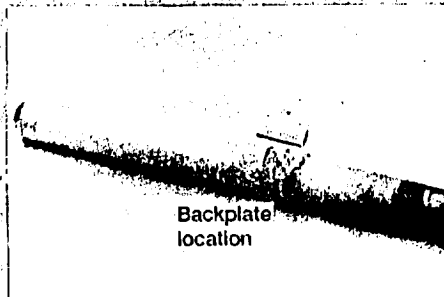
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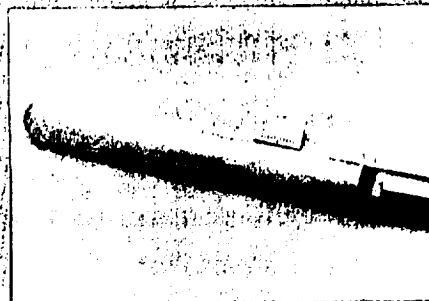


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## MPD Thruster Lifetime Cathode Erosion



- Low purity Argon (99.995%)
- No vacuum purge



- High purity Argon (99.999%)
- With vacuum purge

Major cause of cathode erosion eliminated

CD-92-01450

## Applied-Field MPD Thruster Geometry/Operation Point Selection

### Cathode

- Testing showed hollow cathode temperature was ~ 1000 K below rod cathode

### Boron Nitride Backplate

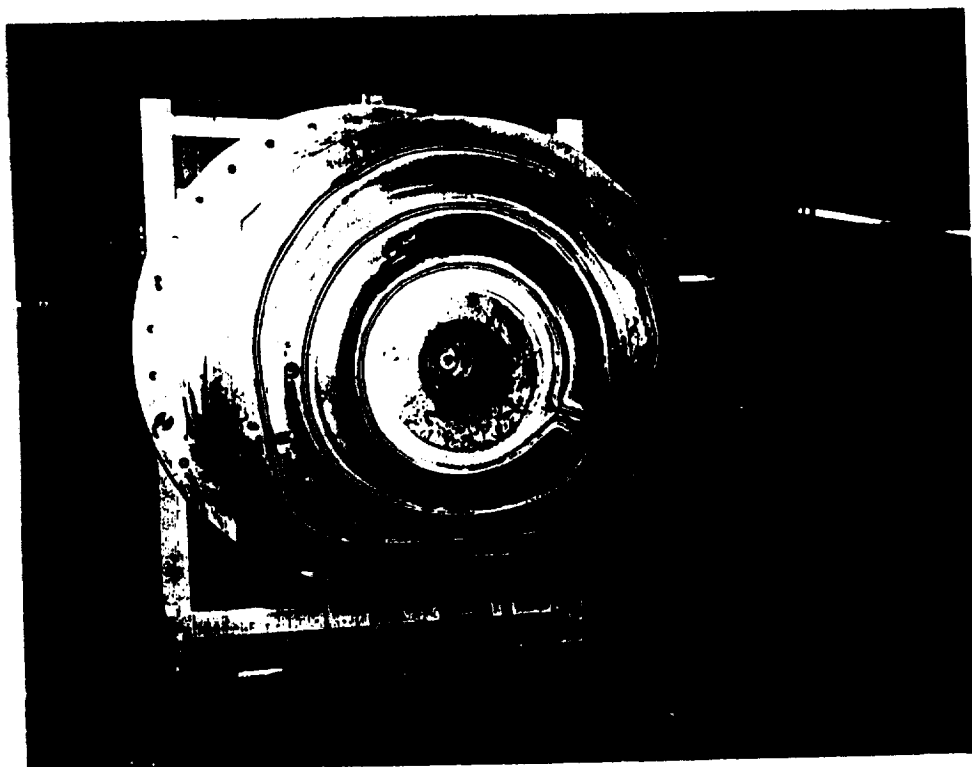
- Increasing cathode-to-backplate separation improved insulator life

### Anode

- 5.1 cm radius, 15 cm long anode to reduce power density

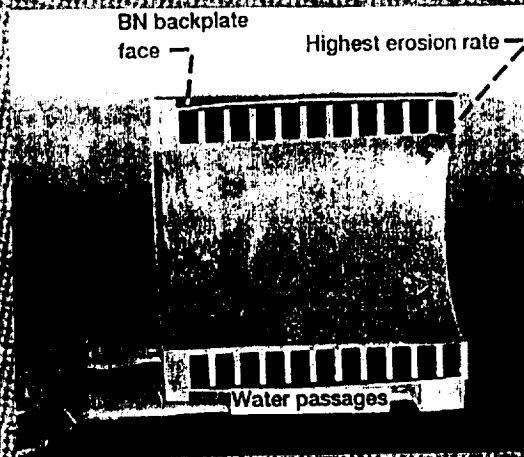
### Operating point

60 kW: 1400 amps, 47 volts  
0.14 g/s argon



## MPD Thruster Lifetime Anode Erosion

Extended test conducted to identify first order failure mode



Sputtering by argon propellant identified as major cause of erosion  
fundamental limit for Isp's of interest

Program emphasis shifted toward light propellants  
and refractory metal anodes